What can we learn from the comparisons of aerosol simulations by GMI and GOCART

Huisheng Bian

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Mian Chin, Xiaohong Liu, Joyce Penner, Minghuai Wang, Thomas Diehl, Jose Rodriguez, Bryan Duncan, Susan Strahan

Motivation

Use GMI as a test bed to identify and reduce uncertainties in global aerosol simulations

Approach

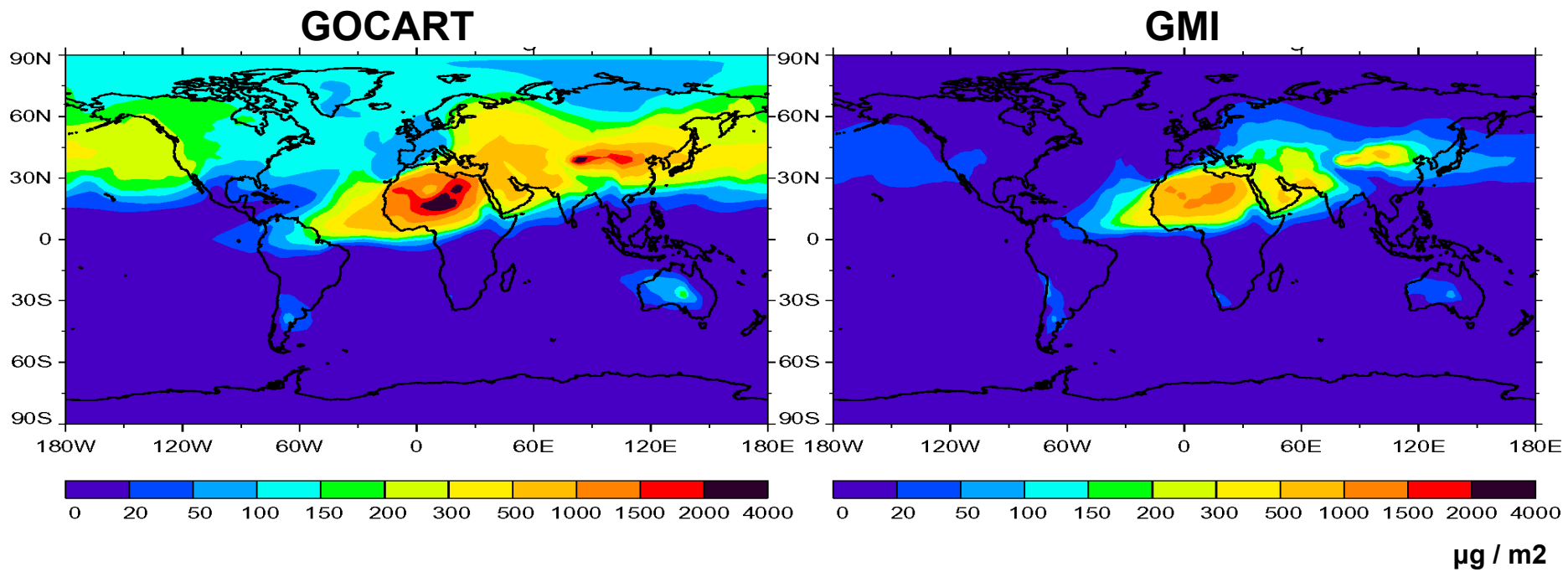
- Compare aerosol simulations from two offline global aerosol models: GMI and GOCART

- Similarity of the simulations: same spatial resolution; same driving assimilation meteorological fields (GEOS4); and same dynamical transport.

- Differences in the simulations: different emission, wet scavenging, chemistry, and aerosol optical properties. (Simulations indicate uncertainties due to these processes)

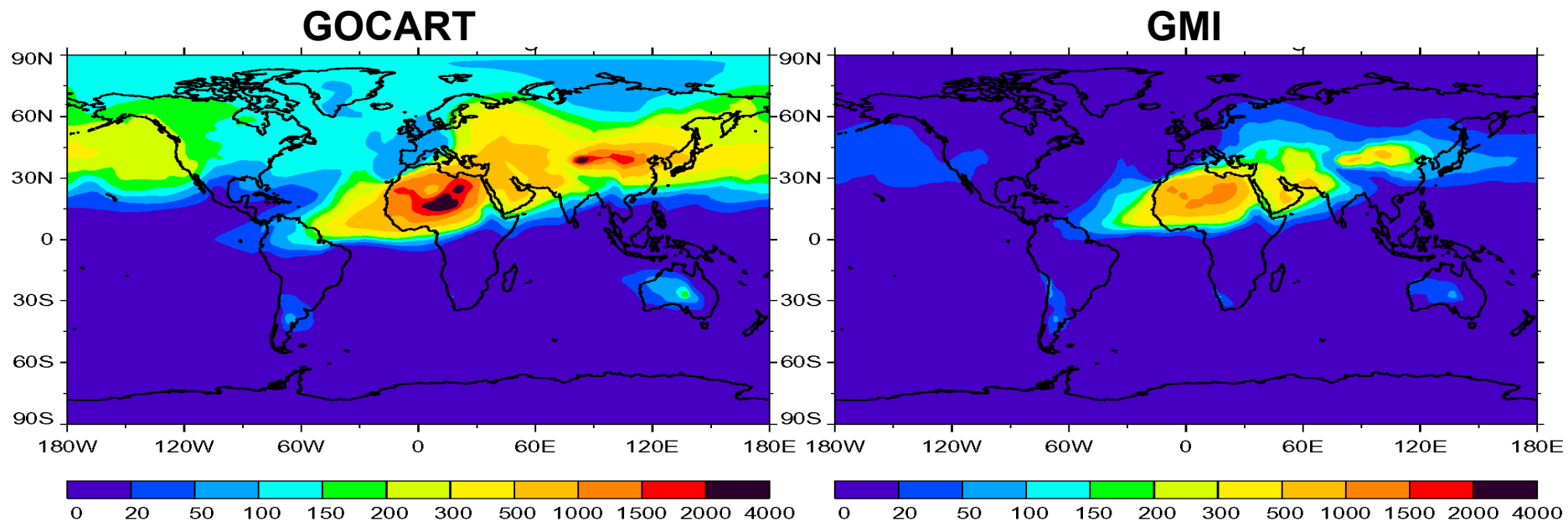
- The study period is April 2001

Column Dust

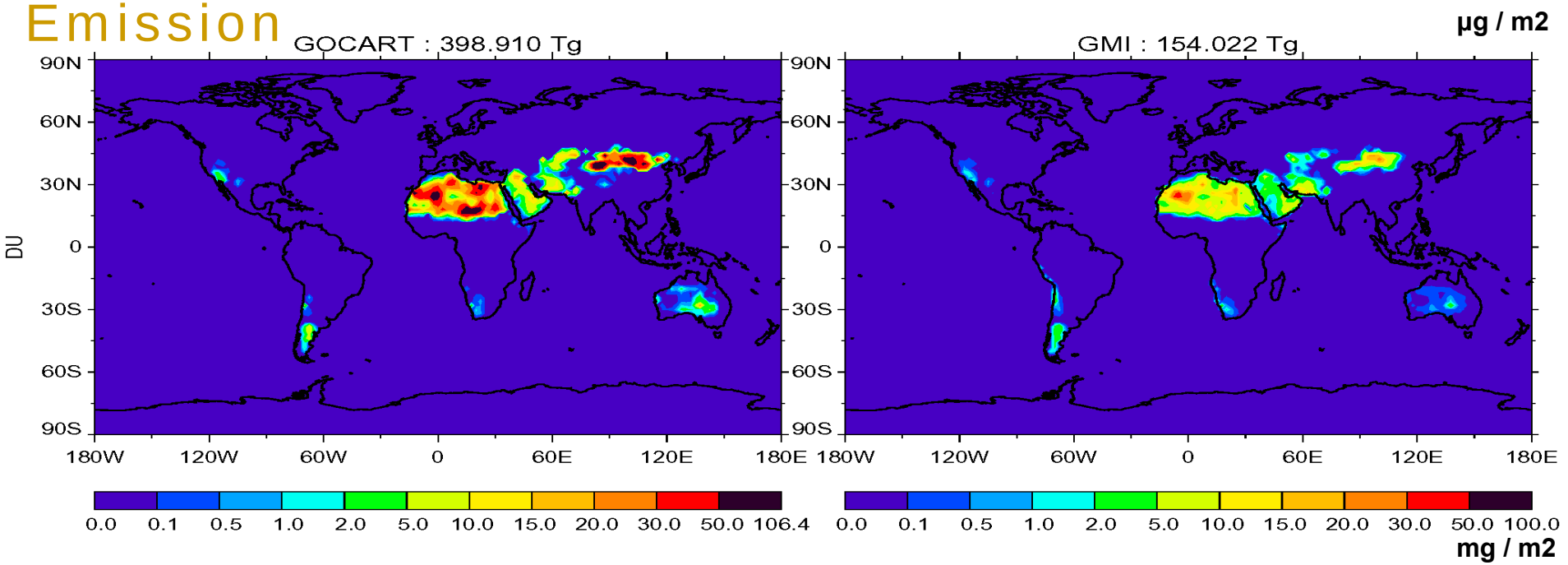


	burden (Tg)	lifetime (days)
GOCART	67.9	5.1
GMI	20.7	4.2

Column Dust

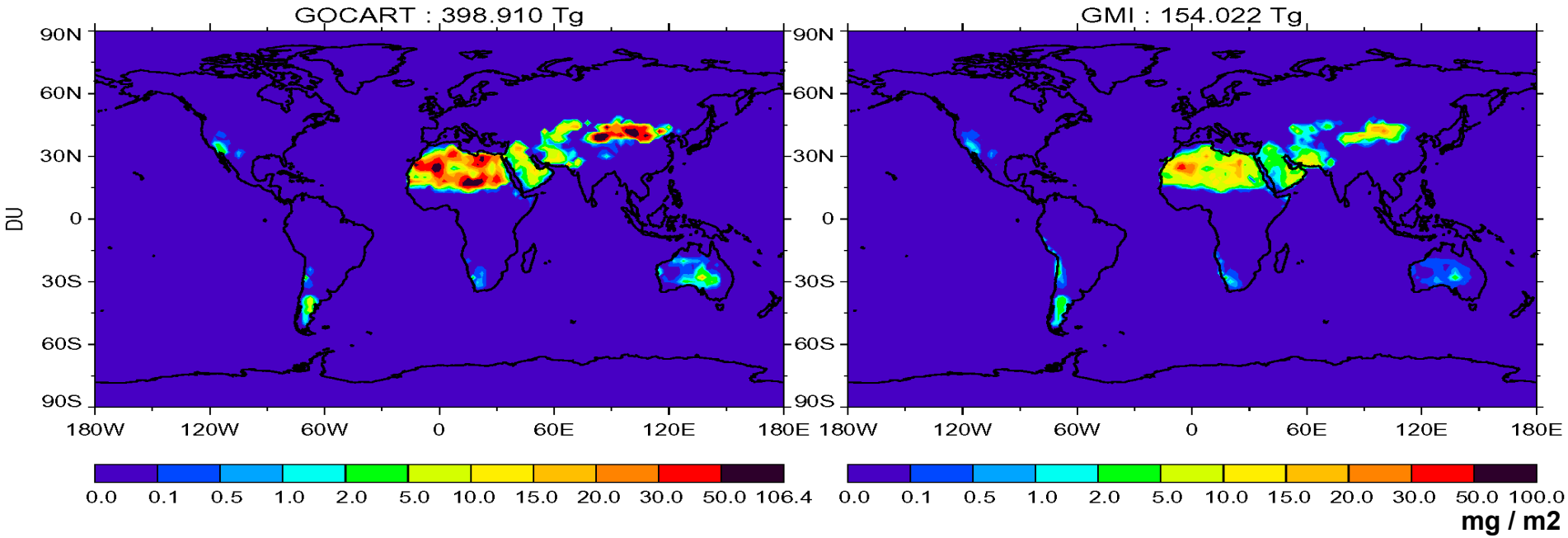


Emission



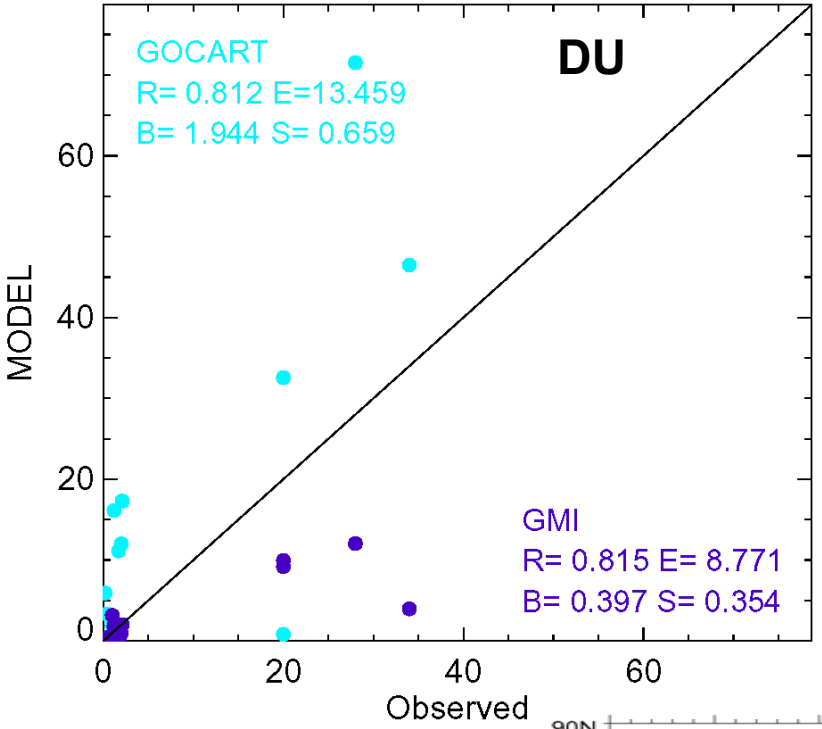
Emission Dust

GOCART	GMI
Ginoux's algorithm	Ginoux's algorithm
Online calculation	Read in Ginoux's dataset
(from archived winds, soil characteristic, etc.)	(every 6 hours)

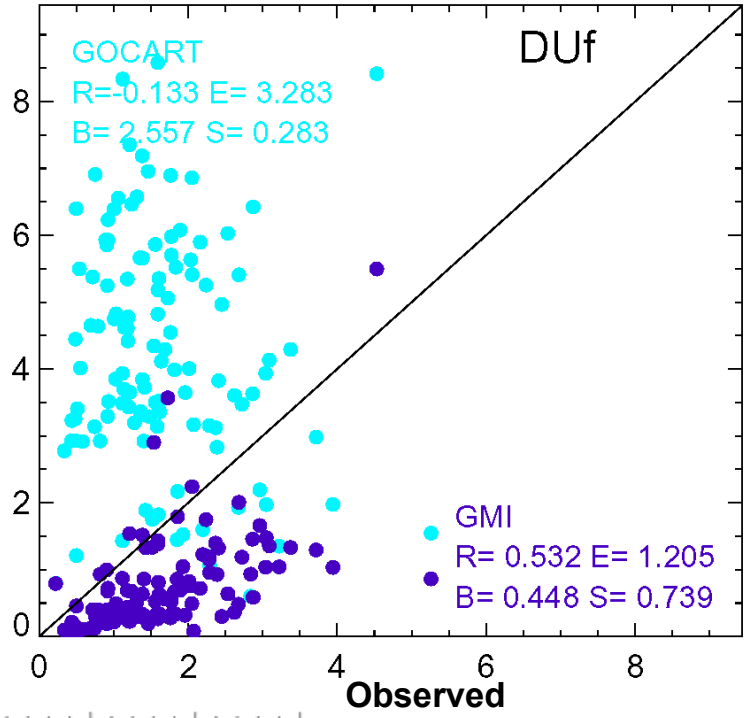


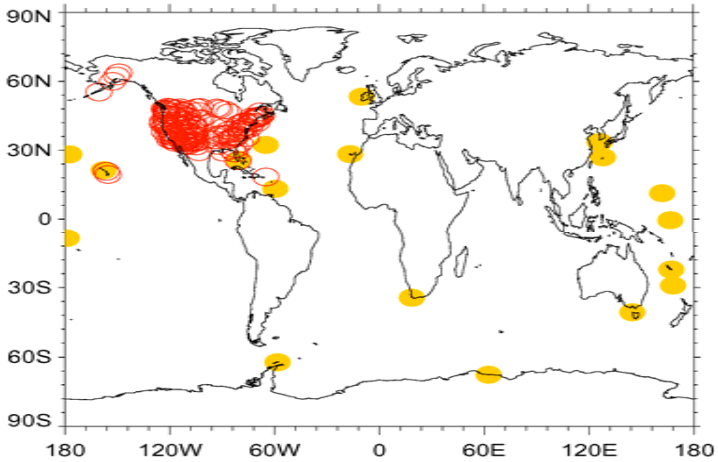
Model-Observation Comparisons (Dust)

Global



North America

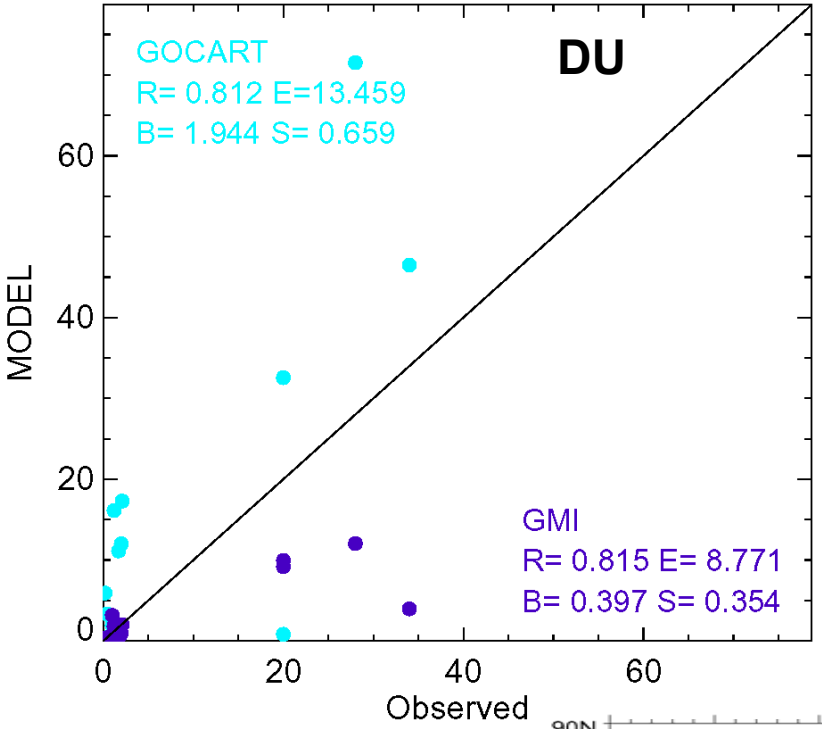




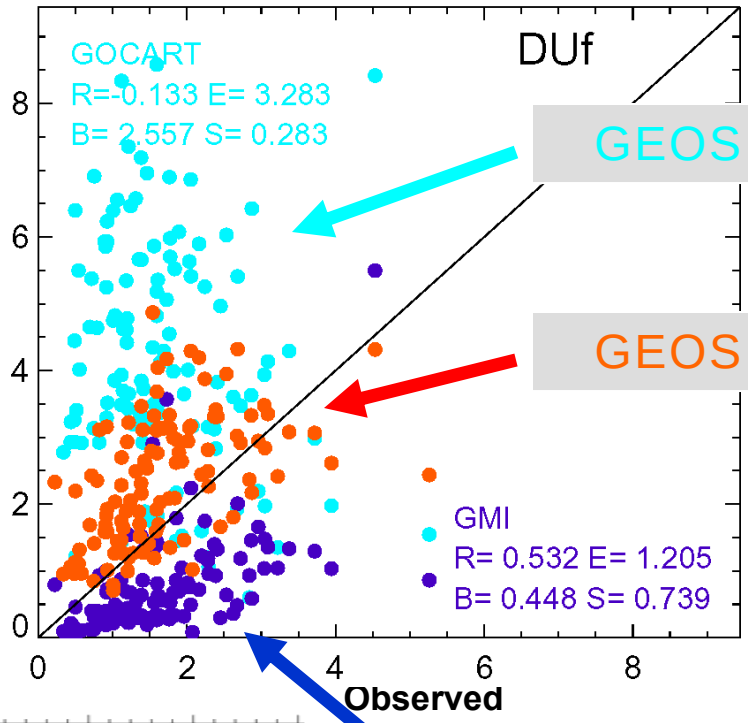
Station sites

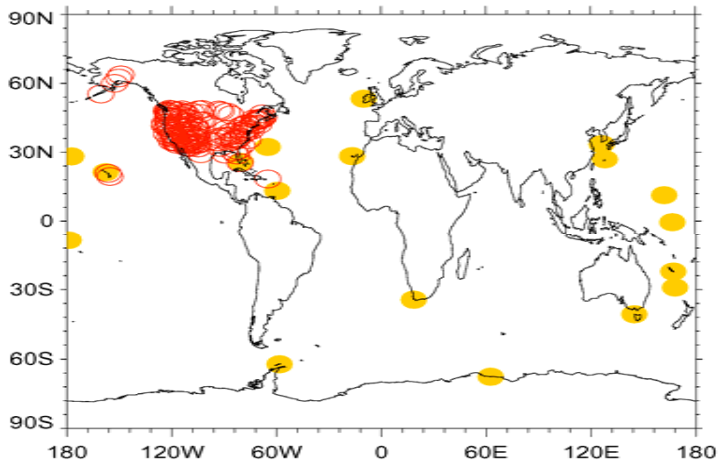
Model-Observation Comparisons (Dust)

Global



North America



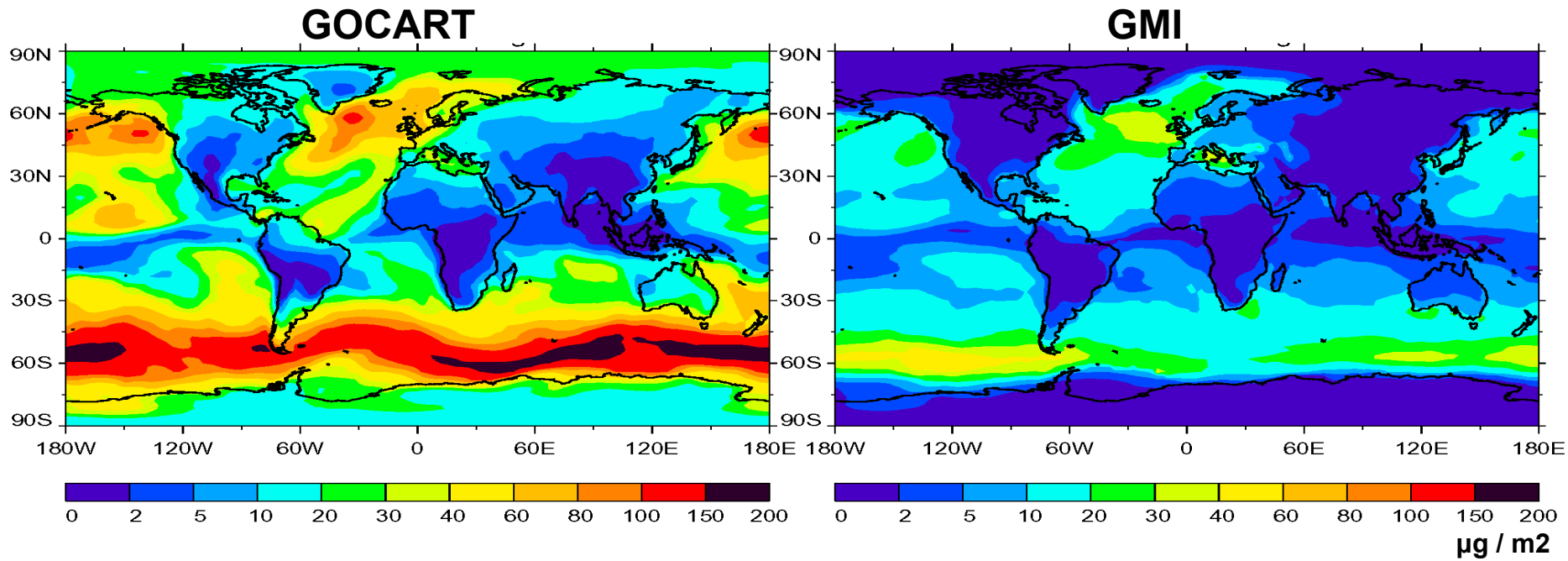


GEOS 4

GEOS 3

GEOS 1

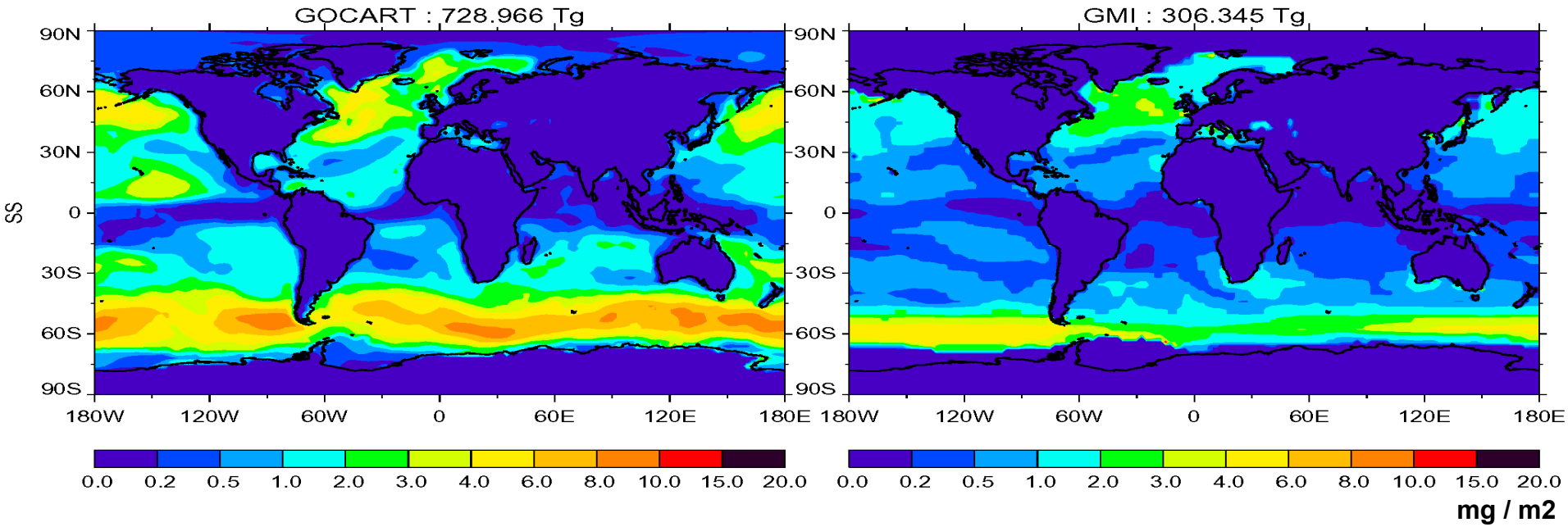
Column Sea Salt



	burden (Tg)	lifetime (days)
GOCART	18.1	0.74
GMI	4.8	0.47

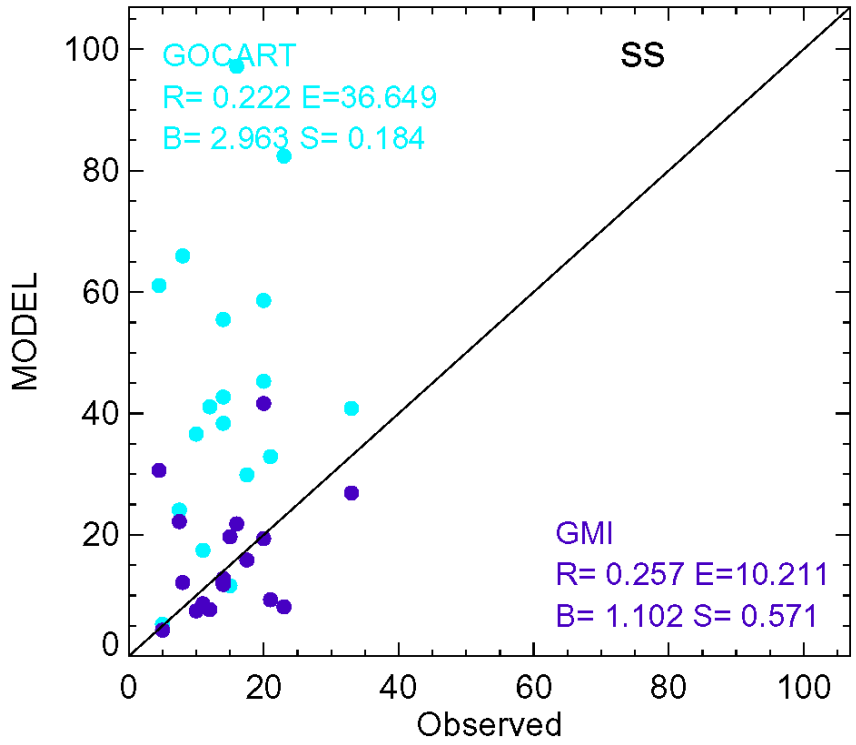
Emission

GOCART	GMI
Gong [1997] and Monahan [1986]	Same
Online calculation	Read in Gong's dataset
(from archived winds)	(monthly)

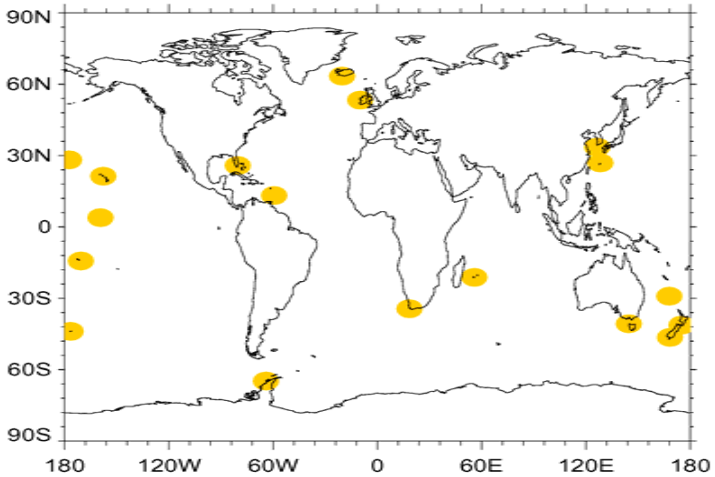


Model and observation comparison (Sea-salt surface mass)

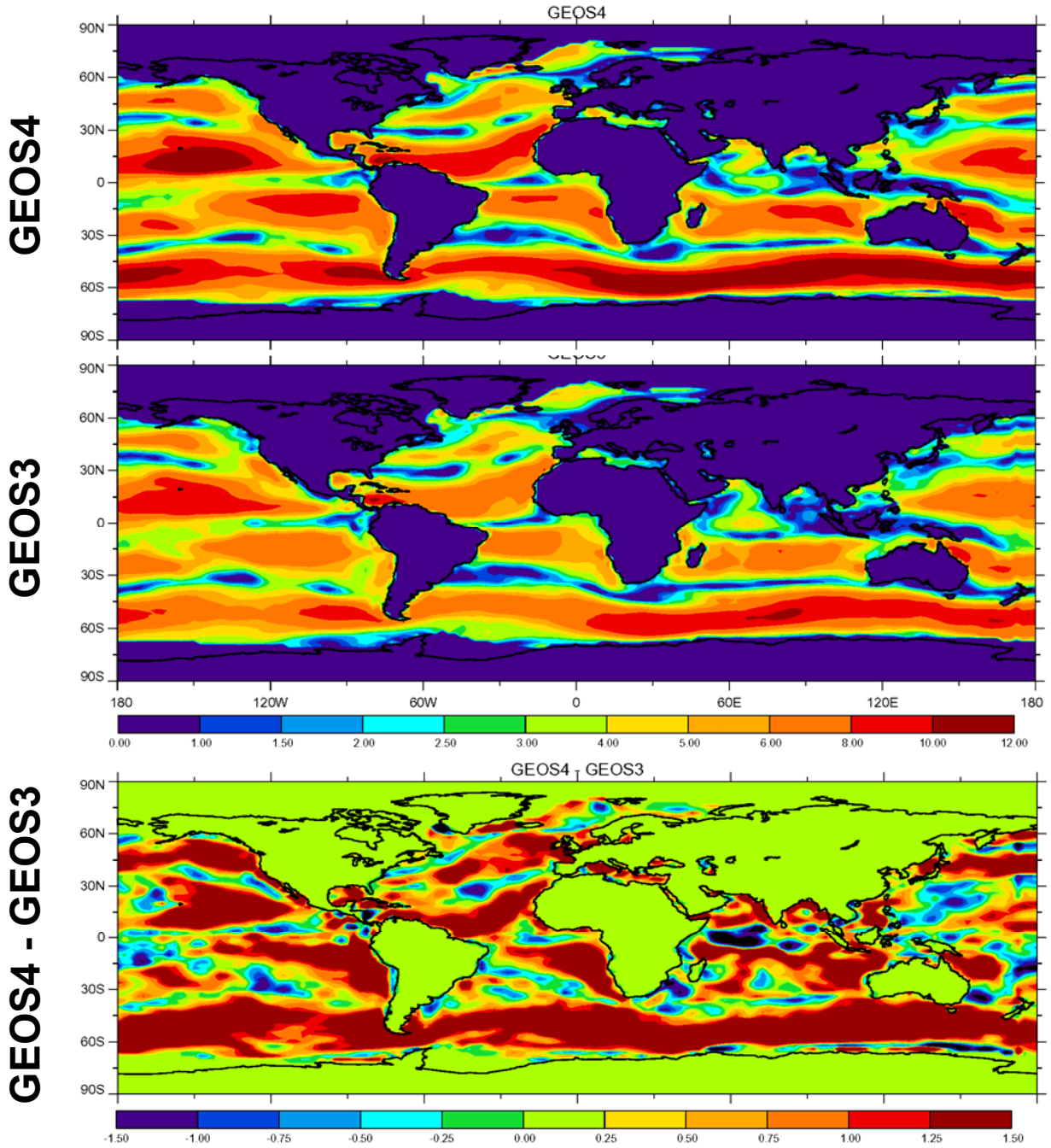
Global



Station sites



Ocean Wind (sqrt(u**2+v**2))



Max: 12.5 m/s

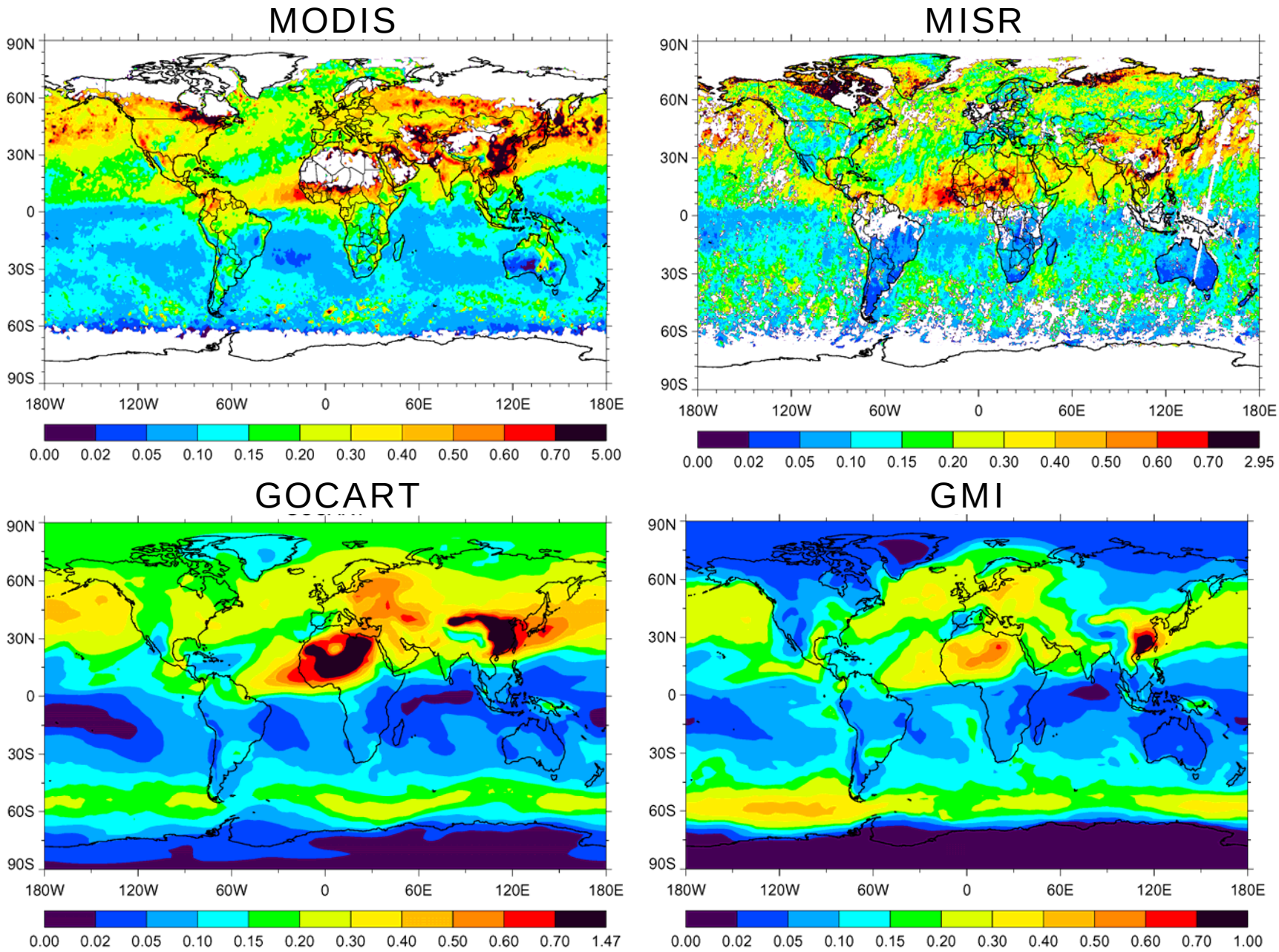
Avg: 5.5

Max: 10.4

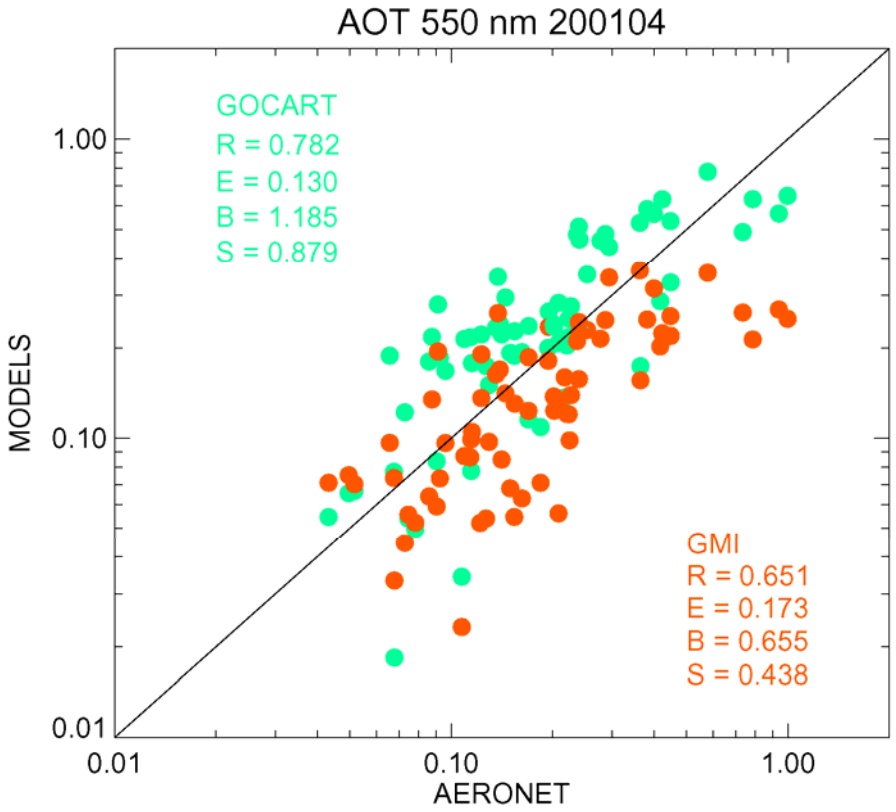
Avg: 4.7

GEOS4 is 17% higher than GEOS3

AOT at 550nm


MODIS
90N
60N
30N
0
30S
60S
90S
180W
120W
60W
0
60E
120E
180E
0.00 0.02 0.05 0.10 0.15 0.20 0.30 0.40 0.50 0.60 0.70 5.00
MISR
0.00 0.02 0.05 0.10 0.15 0.20 0.30 0.40 0.50 0.60 0.70 2.95
GOCART
0.00 0.02 0.05 0.10 0.15 0.20 0.30 0.40 0.50 0.60 0.70 1.47
GMI
0.00 0.02 0.05 0.10 0.15 0.20 0.30 0.40 0.50 0.60 0.70 1.00

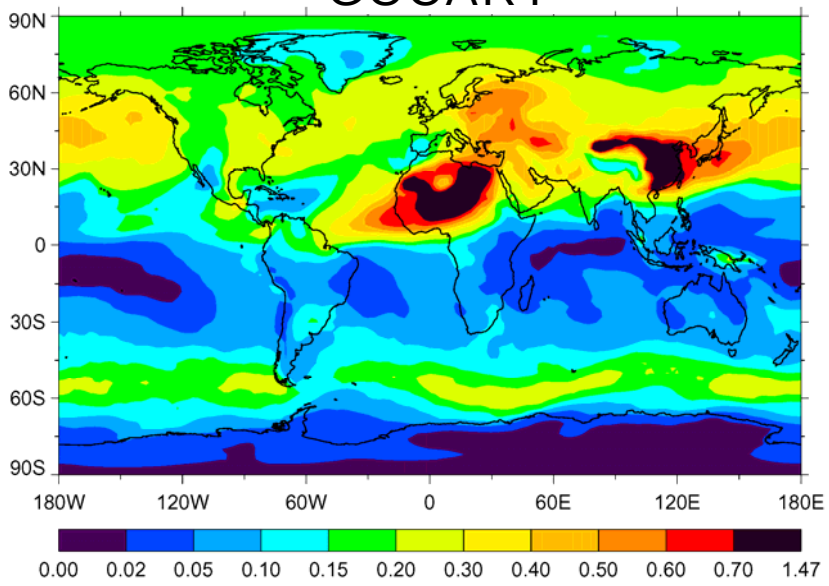
Comparison (model and AERONET)



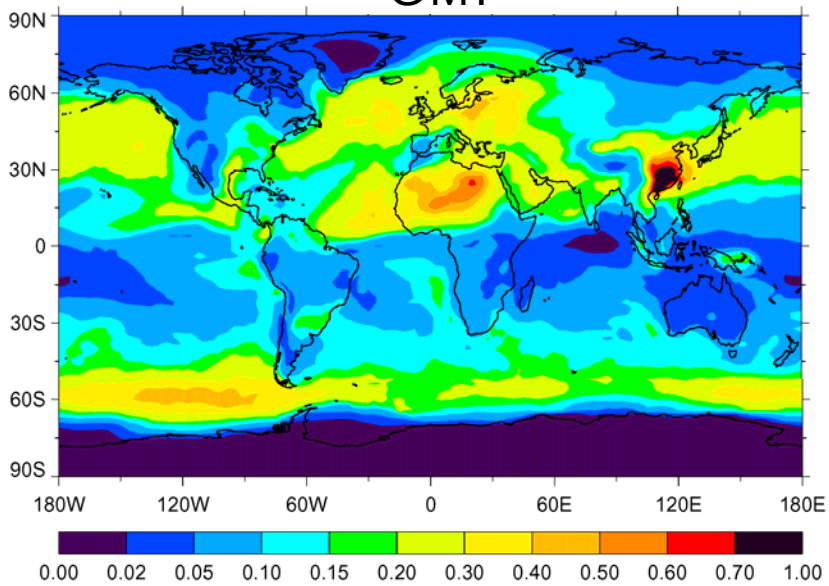
Compared with AERONET measurement, model AOT is globally higher for GOCART and lower for GMI.

Masses vs Optical Properties ?

GOCART

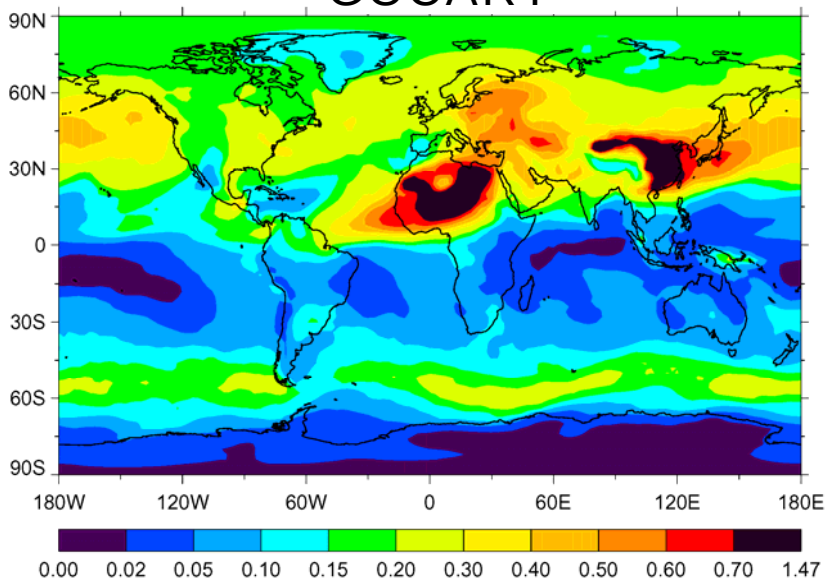


GMI

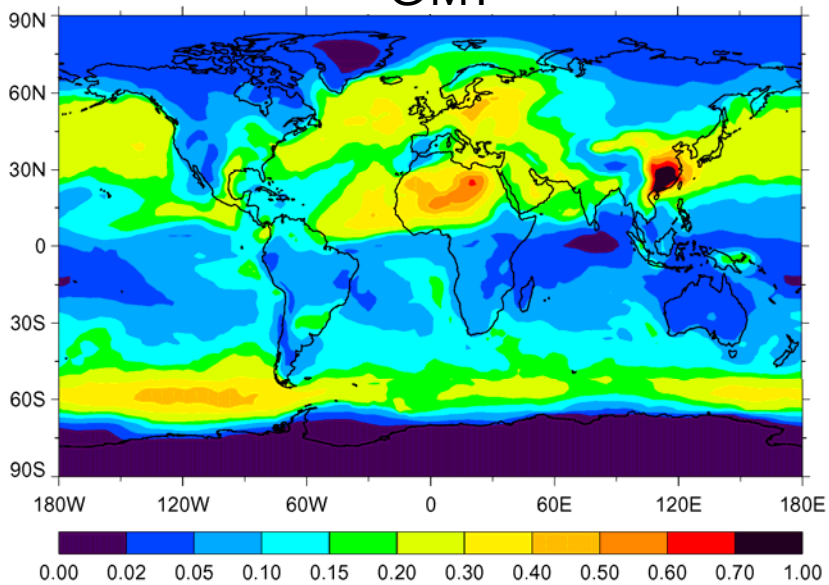


Masses vs Optical Properties ?

GOCART

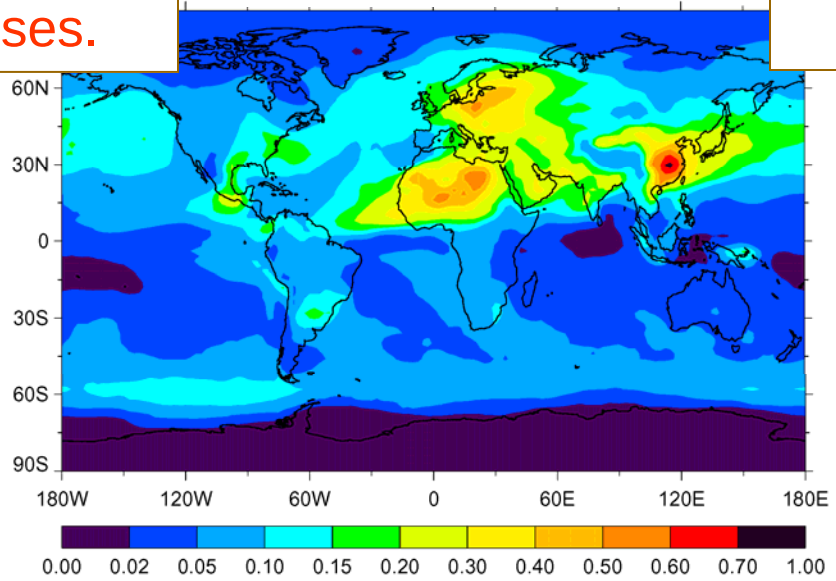


GMI



dAOT due to different aerosol masses.

GMI-GOCART

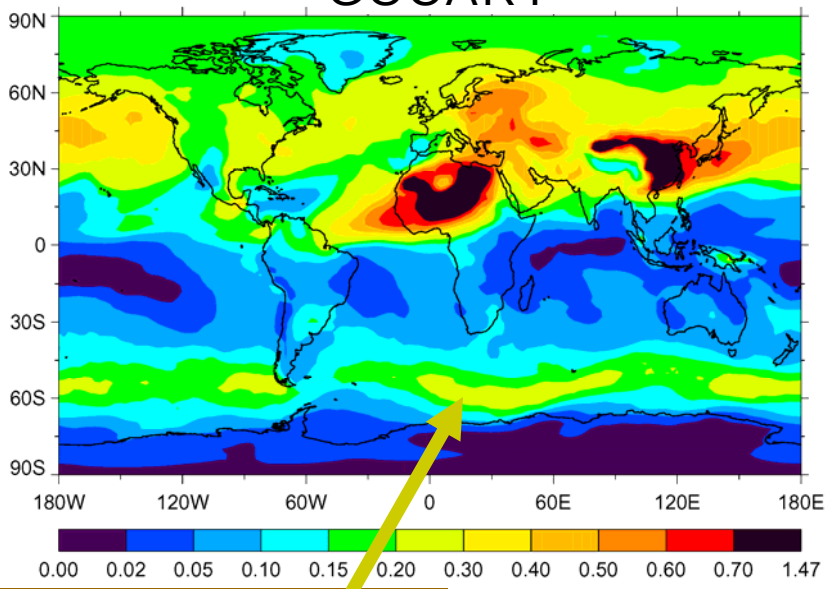


dAOT due to different aerosol optical properties.

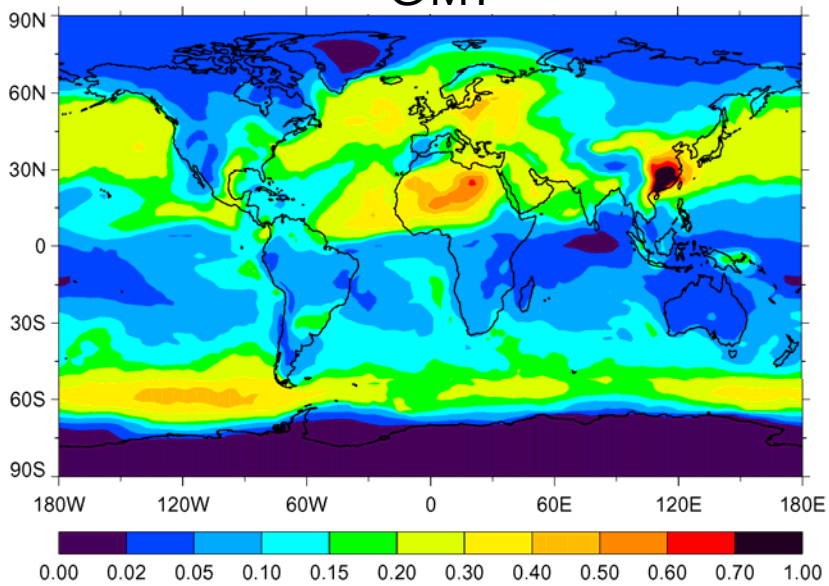
GMI_GOCART: AOT calculated using GMI aerosol mass and GOCART aerosol optical properties.

Masses vs Optical Properties ?

GOCART



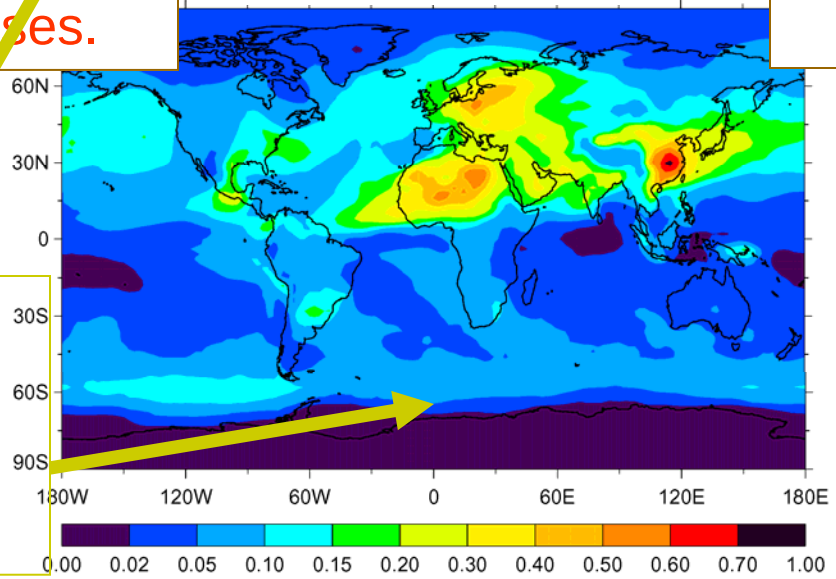
GMI



dAOT due to different aerosol masses.

dAOT due to different aerosol optical properties.

GMI-GOCART

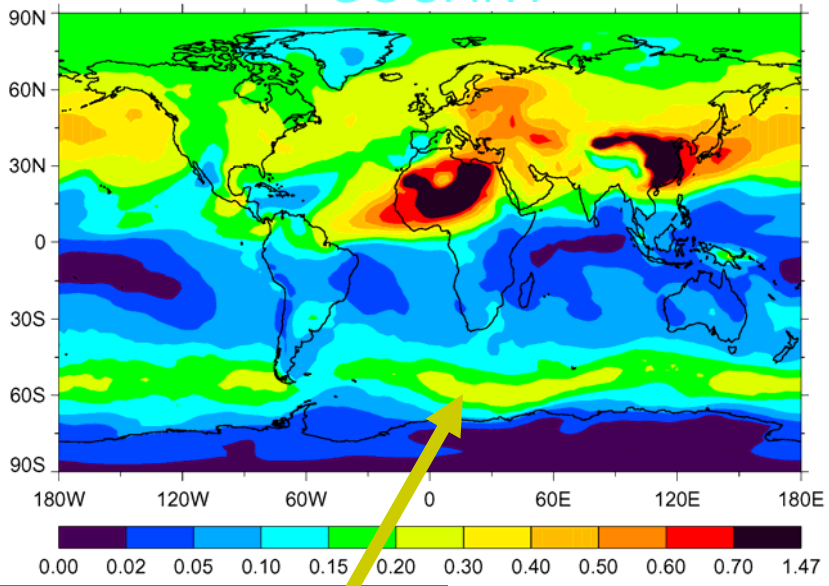


Sea-salt burden (Tg)	
GOCART	**18.1**
GMI	**4.8**

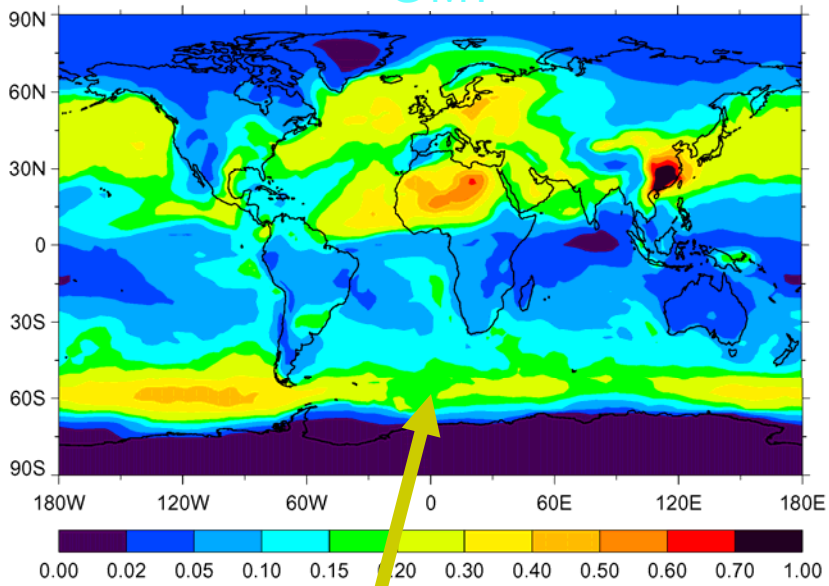
GMI_GOCART: AOT calculated using GMI aerosol mass and GOCART aerosol optical properties.

Masses vs Optical Properties ?

GOCART

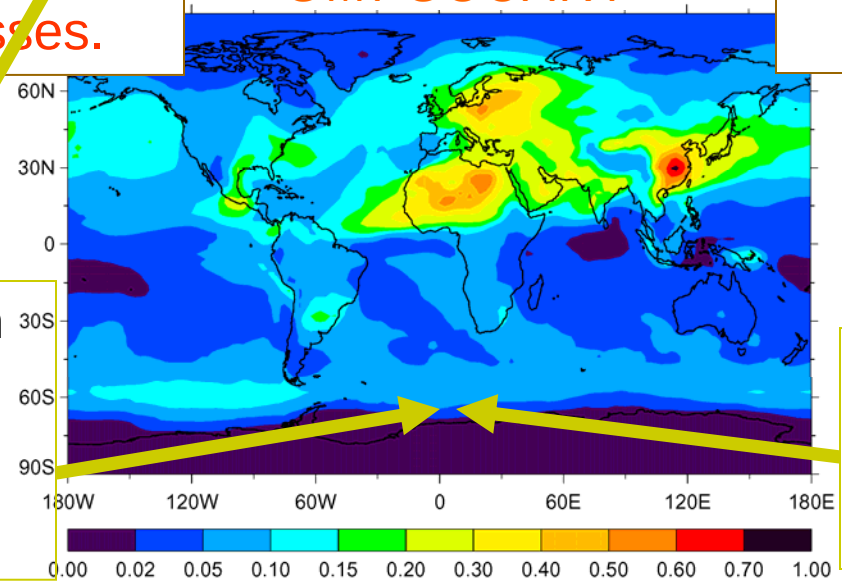


GMI

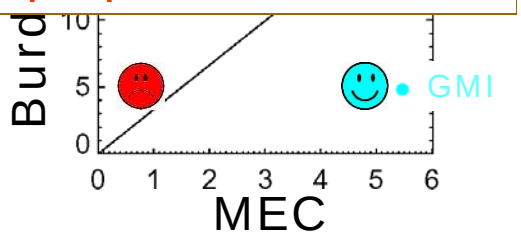


dAOT due to different aerosol masses.

GMI-GOCART



dAOT due to different aerosol optical properties.



Sea-salt burden (Tg)

GOCART 18.1

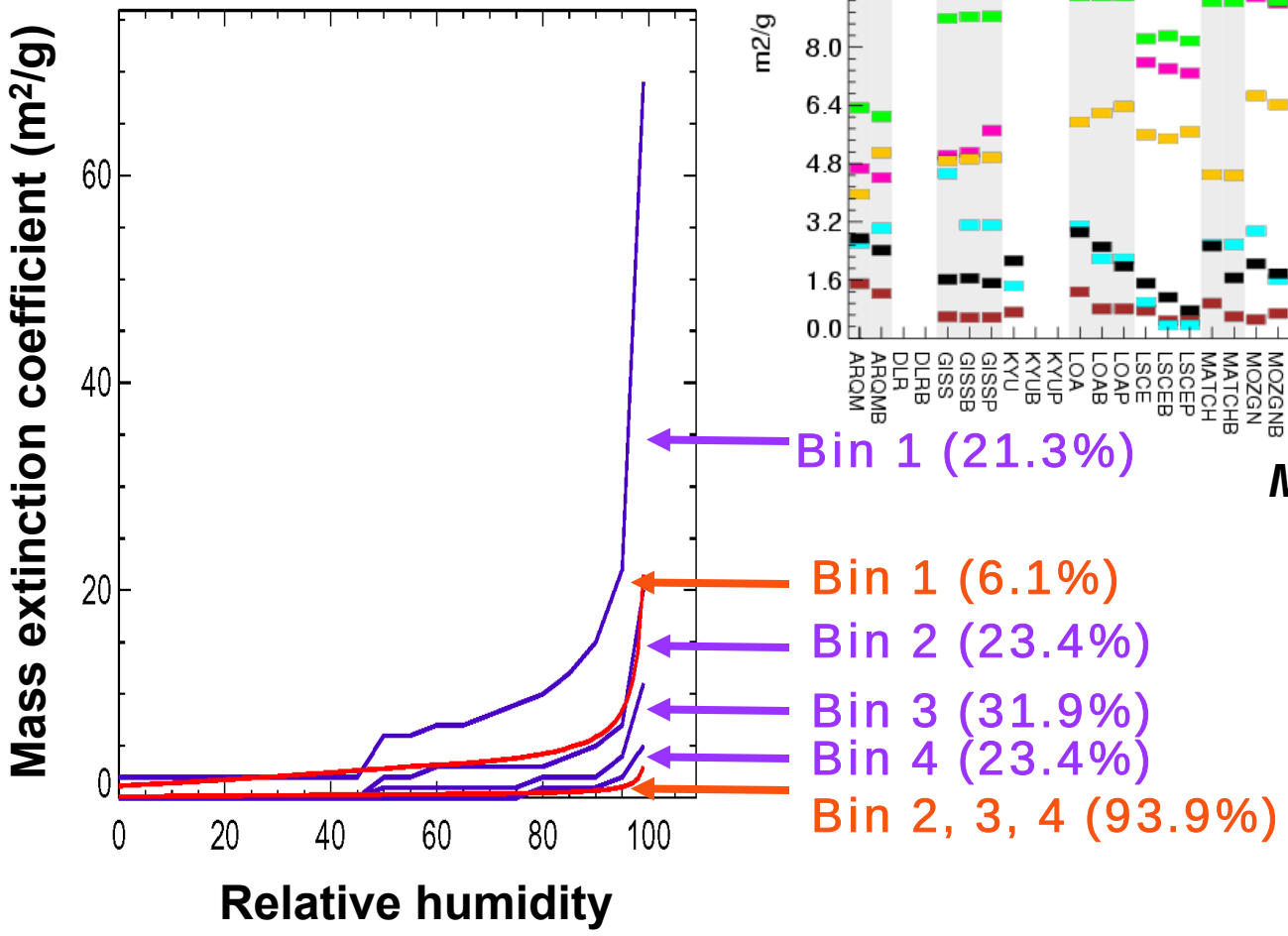
GMI 4.8

Sea-salt mean MEC (m2/g)

GOCART 0.90

GMI 5.47

Sea-salt mass extinction coefficient used in GMI and GOCART



Bin 1 (6.1%)

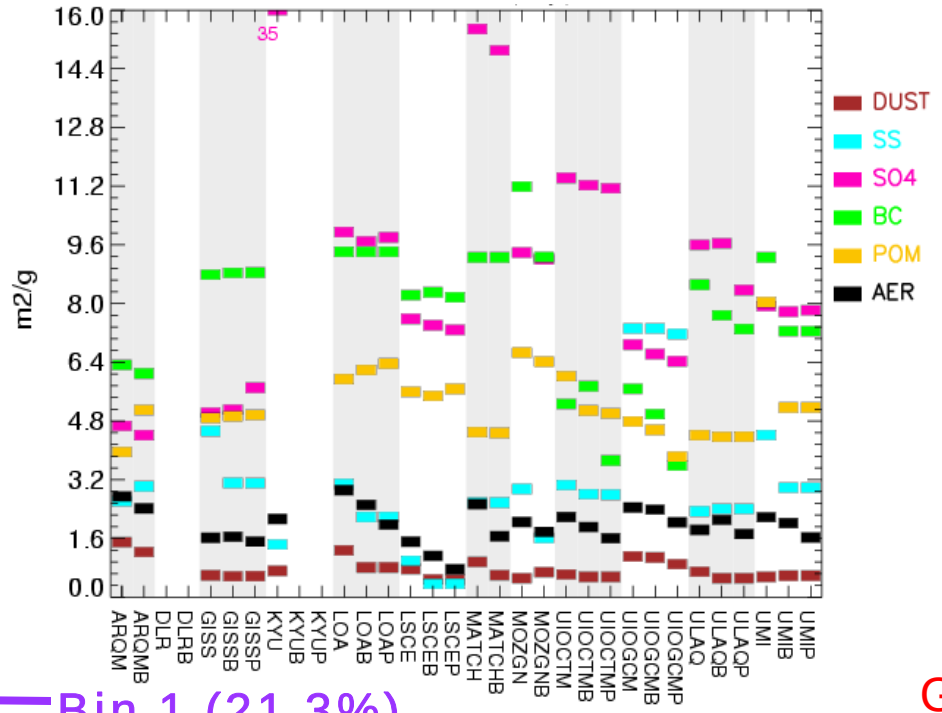
Bin 2 (23.4%)

Bin 3 (31.9%)

Bin 4 (23.4%)

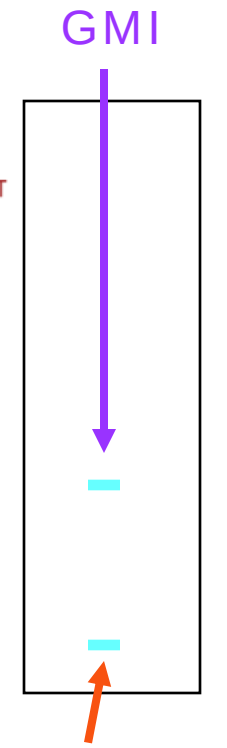
Bin 2, 3, 4 (93.9%)

AEROCOM



Bin 1 (21.3%)

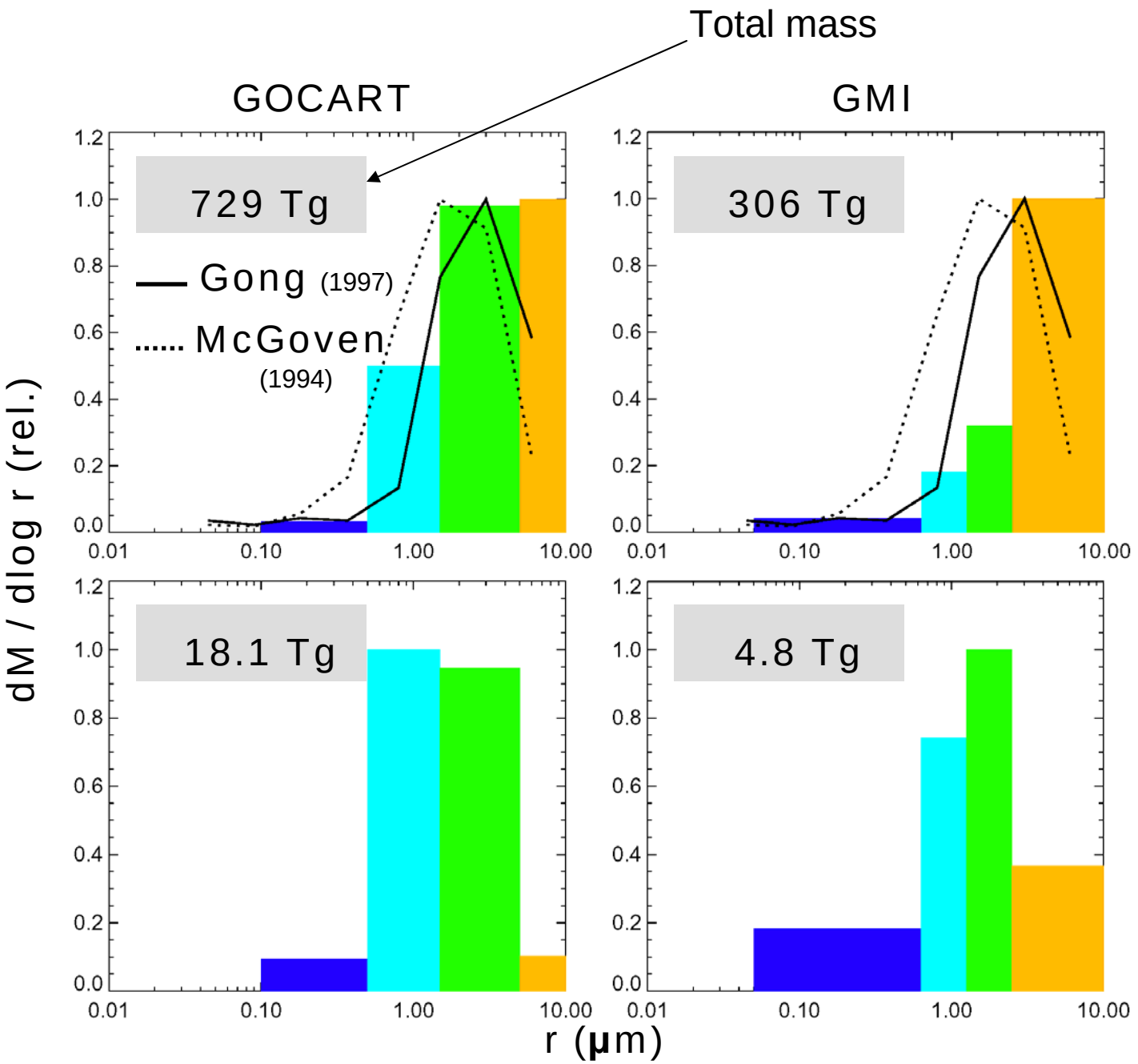
Michael Schulz



Sea-salt mass size distribution

EMISSION

BURDEN



Summary

1. There are significant difference between aerosol mass and AOT distributions simulated by GOCART and GMI, even if we use the same meteorological fields.
2. GOCART has an advantage in calculating emissions of DMS, dust, and sea salt on line and the emission reality is relied on the driven meteorological fields;
3. The lifetimes of aerosols in GMI are significantly lower than those in GOCART, which suggests the importance of different treatment of wet removal.
4. Model evaluation using AOT from satellite and AERONET is necessary, but not sufficient.